The Canadian Entomologist.

VOL. XXV. LONDON, AUGUST, 1893. No. 8.

SOME INTERESTING COLOUR-VARIETIES IN THE GENUS CROSSIDIUS.

BY H. F. WICKHAM, IOWA CITY, IOWA.

While engaged in the re-arrangement of some boxes of Cerambycidæ recently, the peculiar modifications of the ordinarily very simple pattern of coloration in the genus *Crossidius* brought about the desire to see to what extent and under what circumstances certain of these modifications were carried on or existent. The results of the studies ensuing thereupon are presented in the present paper.

The pattern which may be regarded as the typical one, and upon which all the others are built, either by simple addition or subtraction, is as follows :—Head black, thorax black with yellow side margins, elytra yellow with the humeri and a large elongate common sutural spot black. I do not wish it understood, however, that this is to be regarded as the original pattern from which the others have been evolved through the processes of natural or sexual selection—only as a common plan of coloration, and one which forms a convenient standard of comparison.

In habit the beetles are diurnal, frequenting flowers of golden-rod and other yellow-flowered Compositæ, more especially in the arid regions of the United States and southward. In our faunal limits the genus is found from Montana and Oregon to Texas and Southern California, spreading over a vast extent of territory, and one of great differences in climatic and atmospheric, as well as of geologic characters. Under these circumstances we might well expect to find the genus composed of either many more or less closely allied species, or one or few very variable ones. My own experience goes to show that, in this group, those species of wide distribution offer many interesting variations, and to bring some of these before the reader I have prepared the accompanying plate, wherein the body and antennæ of the insects are represented in a conventional manner, and all accuracy of delineation confined to the points under discussion—the elytral pattern.

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That the yellow ground colour of most of the species is of protective value, and that the black markings aid in this object by breaking the continuity of outline, I think no one will contradict who has seen these insects in their natural homes, whether he be a believer in any of the theories advanced to account for this phenomenon or not. That the variation within specific limits is also very great will not be denied by one who has seen cabinet series from various parts of the country; but the meaning of this variation and its co-relations, if such there be, with the multitudinous incidents of food, size, habitat, altitude, temperature and moisture, are not to be made out at a sitting, but will take years of thought and labour to demonstrate. The few facts, for the bringing forward of which the present paper was written, may none the less serve a useful purpose in aiding those whose investigations are of a parallel nature to keep a sort of check on their own investigations, or to find that the work of others may help to bear out the conclusions arrived at in their own.

The figures *a* to *j* of the accompanying plate represent some of the forms shown by *Crossidius pulchellus* from southern localities. It will be noticed that the lightest forms, *h* and *i*, are both males, while the darkest, *c*, *d* and *e*, are females; the male shown at *j* is, however, darker than the females shown at *a* and *b*, the pattern resembling more closely that of *g*, though the males with fusiform sutural blotch, *h* and *i*, are lighter than the correspondingly marked females *a* and *b;* this is true also of the male with shield-shaped spot *(j)*, and its corresponding females, *c*, *d*, *e*, *f* and *g*. The females, among themselves, show an increase in comparative size of the dark spot with decrease in actual size of the insect, as will be seen by comparisons of the hair-lines indicating the length of each specimen figured. The inference to be drawn here is that the female tends to the possession of increase of black markings over those of the male, and that the smaller specimens are likely to be darker than the larger.

Figures *q*, *r*, *s* and *t* are of specimens which have been referred to *C. hirtipes*, but which I am inclined to consider simply a small form of *C. pulchellus*, since they do not agree with the description of the former species. These are all females, and do not bear out well the conclusion which would seemingly be justified by the preceding series that the small specimens are darkest, since *r* is a lighter form than the larger *s*. At *t* is shown a curiously marked specimen in which the humeral spot is prolonged backward, connecting with the sutural mark at what is, in most specimens, its antero-lateral angle. This may be compared with fig. *e* where a somewhat similar conjunction is brought about, not so much by the prolongation of the humeral spot as by the extension forward of the sutural patch.

Figure *k* represents a form of coloration sometimes seen in the male of *C. longipennis*, Casey, of which species a series of fifty specimens, all from Albuquerque, New Mexico. lies before me. Of these only two of the males are so heavily marked with black as the figure, while all but two of the females are darker, the majority tending towards *a* (but lacking the humeral spot), while one is almost as dark as *q*. In this species, as in *pulchellus*, the females are the more heavily marked with black, but the size of my specimens is so constant that no correlation can be traced between size and colour. It may be worthy of remark, however, that the specific pattern of coloration involves much less black than that of *C. pulchellus*, while the actual size of the insect averages much greater—an indication of a tendency in large species in this genus to become light-coloured as well as large individuals of some of the species.

At *l* is shown a specimen of *C. intermedius*, which will illustrate the pattern of coloration of the only specimen I possess. It differs from most of its congeners in having pale legs and antennæ, and inhabits the drier portions of the southern plains in the same localities, and with the same habits, as *C. pulchellus*, though the range is probably much less extended.

C. nitidicollis, Casey, is represented by figures *m* and *n*, and is found in the neighborhood of Tucson, Arizona, and on the foothills of the mountains near by. It will be noticed that the male shows very little black, while the female is quite dark, almost exactly resembling fig. *f* of *C. pulchellus*. Here we find the female, as usual, darker than the male.

In the figures *o* and *p*, which show the markings of *C. discoideus*, a red and black species, is noticed an extension anteriorly of the sutural mark, which here reaches the base of the wing covers, with, in one case, a corresponding increase of the humeral spots which have been spread over the whole base of the elytra, and become confluent with the sutural blotch. Both specimens are females, so no sexual comparisons can be made, though the small specimen is the darker. My specimens are from the high mountains of Colorado (Cockerell) and from Williams, Arizona, the latter place at an altitude of between 6,000 and 7,000 feet.

The results of some researches regarding melanism in insects have lately been published by Mr. J. W. Tutt, of London, England. He believes that moisture is the chief excitant cause of melanism, and has offered proof to show that among the British lepidoptera the darkest forms are commonest in the more humid parts of England. Given an excitant cause, he shows that as moisture in the atmosphere tends to darken the soil, trees and other natural objects, natural selection would, if not interfered with by opposing forces, tend to perpetuate the melanic forms. This line of thought has suggested to me the desirability of making some inquiries regarding the climatic conditions of the different regions from which my own specimens come. A request for figures stating average annual precipitation has at once been acceded to by Prof. Mark. W. Harrington, Chief of the U. S. Weather Bureau, who has kindly sent me the appended statistics :—

Annual	precipitation at	Albuquerque, New Mex.,	7.19 in.	May to	Oct ,	5.42 in.
"	"	Helena, Montana,	13.22 in.	"	"	7.90 in.
"	"	Flagstaff, Arizona,	25.95 in.	"	"	9.12 in.
"	"	Prescott, Arizona,	17.06 in.	"	"	8.50 in.

In most of these cases the observations have extended over a number of years, but the record for Flagstaff, Ariz , has been kept for only seventeen months, and Prof. Harrington writes me that it may be too high an average. My object in getting the figures for the months of May to October (inclusive) is this : If the action of moisture on the colours of insects be purely physiological, it would act chiefly, no doubt, while the insect was growing,—that is, through the active part of the larval stage, extending through the warmer months of the year ; if, on the other hand, it acts indirectly by bringing the tints of the insect, through the work of natural selection, more closely in harmony with the darker colours with which this wet weather would surround it, it must nevertheless act during these same months.

While my paper does not deal exclusively with any one species, those treated of are closely allied, and on this ground it may prove profitable to make a few comparisons.

Fifty specimens of *C. longipennis* from the driest of these points—Albuquerque, New Mexico—show thirty-two males, none of which have more than a very slender line of black along the suture, and eighteen females, most of them coloured like *h*, several as light as *k*, and only one as dark as *b*. *C. testaceus*, from the dry regions of Southern California, is also notable from its lack of black markings. I found *C. longipennis* abundant upon golden-rods *(Solidago)*, which had a very solid head of bloom, without the reliefs of light and shade thrown by the more open inflorescense of the yellow-flowered plants on which my other species were chiefly taken. Dr. Leconte records *C. testaceus* from *Baccharis* without specifying more definitely.

Six specimens of *C. pulchellus* from Williams, Ariz., are of a rather dark form, such as shown by *g* and *d*, with the exception of two males which are somewhat lighter, as *h*, and one darker female, like *e* Four males from Peach Springs and Seligman are a very little lighter than *h*, while two females from the same localities are darker than the males, but not quite as dark as the Williams female. Three examples from Albuquerque are about the same as the Peach Springs specimens. A series of nineteen specimens from Helena Mon., averaging much smaller than those of other localities, are of a type very nearly the same as the Williams specimens, so far as regards the extent of black markings.

Summing up the evidence, then, we find:

1. Light specimens *(C. longipennis)* at Albuquerque, where the precipitation is 7.19 inches.

2. Darker ones *(C. pulchellus)* at Peach Springs and Seligman, where it is about 17. inches.

3. Still darker ones at Williams, where it is about 25.95 inches.

4. Specimens about the same as these last from Helena, Montana, where it is about 13.22 inches.

Now we have to reconcile with it, if we are to accept Mr. Tutt's theory at all, the phenomenon of specimens from Helena, with a precipitation of 13.22, presenting a phase of coloration as dark as those from Williams, with an annual precipitation of 25 95 inches. This, however, is not a great difficulty, since I have before mentioned the fact that the Helena beetles average much less in size than the more southern ones, and here I think it quite possible that we have the keynote to the whole thing. Mr. Tutt has already* adduced proof that some forms of disease produce melanism, and it has occurred to me that this species *(C. pulchellus)* having its metropolis in the south, where comparatively mild winters prevail, may find it a hard struggle to exist on the plains of Montana, where

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*Melanism and Melanochroism, p 44 *et seq.*

the winters are of exceptional severity. The consequent weakening of the individuals by this undue exposure may produce a stunted and debilitated race, and the effects of this debility be shown in the lack of the bright yellow pigmentation so characteristic of the forms from the dry, warm regions of the South.

I am far from thinking that all has been written upon the subject of the variation in *Crossidius* that the occasion offers, but space has its limits and the material is too scanty to more than indicate in what direction we may look for the explanation of some of the phenomena presented. The data regarding precipitation in the different localities even cannot entirely be relied upon, as I have had to apply the average taken at Flagstaff to Williams, which is but few miles distant, and at very nearly the same elevation. In the same way it has been necessary to take that given at Prescott as approximately correct for Peach Springs and Seligman. However, I hope the article may attract the attention of more of our American students of entomology to a fascinating branch of the science, and that we may soon see in this country a number of workers who will follow out the lines of investigation suggested by our English brothers, and for the furtherance of which they have established a new magazine† especially devoted to the discussion of variation and its manifold causes. Most of my own work in this article has been suggested by the writings of Mr. Tutt, and to his works I would refer those who care to follow up the subject and learn, in a reasonable compass and without the mass of irrelevant matter which encumbers some other recent works dealing with the speculative side of entomology, what new fields of investigation may be opened up to those who like to know the histories of their insects as well as their names.

EXPLANATION OF PLATE.

Figs. *a* to *j*,	*Crossidius*	*pulchellus*, southern forms.
Fig. *k*,	"	*longipennis*, Casey.
Fig. *l*,	"	*intermedius*, Ulke.
Figs. *m* and *n*,	"	*nitidicollis*, Casey.
Figs. *o* and *p*,	"	*discoideus*, Say.
Figs. *q* to *t*,	"	*pulchellus*, Lec., northern forms.

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†The Entomologist's Record and Journal of Variation.